

THE WORK-ENERGY THEORY

Work is something that is done to objects and energy is the ability to do work. Energy provides forces that can do work on objects. One form of energy that is closely associated with work is kinetic energy. If an object at rest is on a frictionless surface and a force is applied to it, the object is set into motion. Work is done on the object but where does it go? The answer is found in the **change in motion** or an increase in its **kinetic energy** kinetic energy can be found mathematically by:

$$K.E. = \frac{1}{2} m v^2$$

The unit is Joule (J)

If a force is applied upon an object and it is over a distance then there has been an increase in the kinetic energy or the work done is equal to the change in motion of the object. Thus, a new relationship exists :

$$W = F d = \Delta \frac{1}{2} m v^2 = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_o^2$$

- 1) A shuffleboard player pushes a .25 kg puck, initially at rest, in a way that causes a constant horizontal force of 6.0 N to act on it through a distance of .5 m. a) What is the kinetic energy and the speed of the puck when the force is removed b) How much work would be needed to bring the puck to rest? c) Suppose the puck had twice the final speed. Would it take twice as much work to stop the puck?
 2-6. a) $\boxed{0.375 \text{ J} \ \& \ 2.6 \text{ m/s}}$ b) $\boxed{0.375 \text{ J}}$ c) No. ~~twice~~
- 2) In a football game a 140 kg guard runs with a speed of 4 m/s and a 70 kg free safety moves at 8.0 m/s. then, a) both players have the same kinetic energy b) the safety has twice as much kinetic energy c) the guard has twice as much kinetic energy d) the safety has four times as much kinetic energy as the guard.
- 3) A constant force of 75 N acts on an object initially at rest and acts through it for .6 m. a) What is the final K.E.? b) If the object has a mass of .2 kg, what is its final speed?
 a) $\boxed{45 \text{ J}}$ b) $\frac{2 \cdot 45}{.2} = \sqrt{450} = \boxed{21.2 \text{ m/s}}$
- 4) A car (m = 1500 kg) is traveling at 13.4 m/s (30 mi/hr) and needs to stop in a distance of 50 meters. What is the force needed to be applied? If we double the speed, does it take double the force or four times the force to stop the car in the same distance? $\boxed{4 \text{ times}}$

$$\rightarrow Fd = \frac{1}{2} (1500) (13.4)^2$$

$$\rightarrow F = \frac{1500 (13.4)^2}{2 \cdot 50}$$

$$\frac{1}{2} (1500) (13.4^2)$$

$$\therefore F = \boxed{2693.4 \text{ N}}$$